CLAIMS

1. A magnetron comprising a cathode and an anode, the anode surrounding the cathode and being arranged to define an interaction space between the cathode and the anode for containing space charge, the magnetron being operable at a desired frequency and having a coupling arranged to receive an injected signal for coupling the injected signal to the cathode the injected signal being at the desired frequency and having a signal phase, thereby causing the magnetron to operate according to the signal phase.

2. A magnetron according to claim 1, wherein the coupling is a non-contact coupling.

3. A magnetron according to claim 2, wherein the cathode is at negative potential with respect to ground.

4. A magnetron according to claim 1, 2 or 3, wherein the coupling comprises a probe extending into a waveguide.

5. A magnetron according to claim 4, wherein the probe comprises an extended portion of the cathode.

6. A magnetron according to claim 4, wherein the probe comprises a separate conductor coupled with the cathode.

7. A magnetron according to any of claims 4 to 6, wherein the probe is arranged to couple to the injected signal formed as a wave in the waveguide thereby coupling the injected signal to the cathode.

8. A magnetron according to any preceding claim, wherein the injected signal is arranged to couple to the cathode and forms a TEM wave in the interaction space.

9. A magnetron according to claim 6, wherein the TEM wave couples to the space charge thereby causing the space charge to oscillate in accordance with the signal phase.

10. A magnetron according to any preceding claim, wherein the cathode being connected to a high voltage supply and having a choke to isolate the high voltage supply form the injected signal.

11. A phase locked magnetron arrangement comprising a plurality of magnetrons according to any preceding claim, wherein each of the plurality being coupled to the injected signal.

12. An arrangement according to claim 9, wherein each magnetron includes a probe extending into a common waveguide.

13. A particle accelerator comprising the arrangement of claim 9.

14. A synchrotron comprising the arrangement of claim 9.

15. A magnetron according to claim 1, wherein the coupling comprises an electrical connection and the cathode is substantially at ground potential.

16. A method of operating a magnetron, the magnetron having a cathode and a surrounding anode defining an interaction space, the method comprising injecting a locking RF signal into the cathode, whereby the magnetron is prompted to operate according to the phase of the locking signal.

17. A method according to claim 16, wherein the locking RF signal is injected as a TEM wave in the interaction space.

18. A method of operating a plurality of magnetrons comprising coupling the cathodes of the plurality of magnetrons to the same RF locking signal, whereby each of the plurality of magnetrons is prompted to operate according to the phase of the locking signal.